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Aztec introduction of the great-tailed grackle in ancient Mesoamerica: Formal defense of the Sahaguntine historical account

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Abstract

The historical account of Aztec Emperor Auitztol's introduction of the great-tailed grackle *Quiscalus mexicanus* into the Valley of Mexico (1486–1502) is significant because it documents human translocation of wild birds in Mexico over 500 years ago, before the Spanish Conquest of that land. In the present paper, which defends the account from writings that dispute it, I first review the evidence of how the account was obtained and show that its many details are consistent with what is known from other sources about both the great-tailed grackle and the Aztecs (Nahuas). I then review and examine all published criticisms of the account and explain in detail why they are wrong. The critics have to date presented no persuasive evidence to support their speculation that the Aztecs confused, or might have confused, a natural invasion for an introduction. In contrast to these critics, Bernardino de Sahagún's research group in the 1500s presented a highly credible, peer-reviewed historical account that documented Aztec introduction of the great-tailed grackle. The pioneering work of these Renaissance Mexican scholars continues to stand as one of the most important records of invasive alien species introduction in ancient times.

Keywords

Ahuitzotl, alien birds, archeobiota, cryptogenic birds, exotic birds, great-tailed grackle, introduced birds, invasive alien species, IAS, invasive birds, Mexico, non-native birds, *Quiscalus mexicanus*, translocated birds

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Introduction

The introduction of the exotic great-tailed grackle *Quiscalus mexicanus* into the Valley of Mexico by Aztec Emperor Auitzotl, was reported by Mexican scholars in the sixteenth century, in one of the earliest scientific works on the fauna and flora of the New World (Sahagún [1577] 1979; Haemig 1978, 2011, 2012). Their historical account of this ancient avian translocation, however, was lost to science for centuries because of dispersal and confiscation of their manuscripts during the Inquisition and, later, the secretive policies of Spanish colonial authorities.

Consequently, it was not until four hundred years after its writing that the account and its implications were finally presented and discussed in an international scientific journal (Haemig 1978). Because biologists had long assumed that introductions of exotic wild birds in the western hemisphere occurred only after European colonization, the revelation of this ancient translocation surprised the scientific world and caused many to wonder how many other birds had been translocated by humans in ancient times (Haemig 1978; Tella 2011).

Today, the account faces a new challenge: Critics have written three papers questioning to various degrees its veracity (Remsen and Cardiff 1990; Christensen 2000; Peer 2011). The most recent (Peer 2011) claims that the great-tailed grackle was only "purportedly introduced" by the Aztecs, and "could also have spread to the area without human assistance." Peer (2011) presents no evidence to explain why he doubts the historical account. Instead, he confidently urges readers to "see Remsen and Cardiff (1990)" who disputed the historical account because their "personal experience with South American indigenous peoples" was "sprinkled with cases of amusing, but obviously erroneous, explanations of past and present natural phenomena".

But Mexico is not located in South America, nor is it correct to judge all indigenous people as unreliable just because some may be so. The sixteenth-century chroniclers of Auitzotl's introduction of the great-tailed grackle were well-educated scholars who used the most rigorous and demanding research techniques of their time to assess the truth and veracity of the information they collected (Lopez Austin 1974; Haemig 2012). They were not naïve fools who believed everything they were told, but rather careful and thoughtful researchers who collected information from reliable sources and verified it using peer review (Haemig 2012). Furthermore, these scholars were fluent in the Aztec (Classical Nahuatl) language and had access to many credible sources of information that are no longer available to us, including distinguished experts from Auitzotl's time, pre-Hispanic pictorial manuscripts that accurately recorded historical events, and surviving members of the Aztec dynastic family (Sahagún [1577] 1982; Haemig 2012).

Therefore, before we believe the claims of those who assert that this ancient bird introduction never happened, we should critically examine their arguments to see if their evidence and reasoning are sound. Accordingly, in the present paper, I carefully consider the claims made by the critics and reply to each one.

I begin with an opening statement that reviews how, when and where the historical account was obtained and the basic facts of Auitzotl's introduction of the great-

tailed grackle. I then show that the details of the historical account are consistent with what other sources say about both the great-tailed grackle and the Aztecs. Next, I examine the claims and arguments made by those who deny the grackle introduction, and explain in detail why I believe them to be wrong. I then make concluding remarks in the discussion.

This paper is the third in a series of three recent articles that I have written on Auitzotl's introduction of the great-tailed grackle. In the first paper (Haemig 2011), I conducted a four-stage analysis of this ancient bird translocation. In the second paper (Haemig 2012), I investigated the origin of the historical account and the team of scholars that collected it. Now, in this third paper, I review the evidence and defend the historical account from its critics.

Opening statement

During the years 1561–1565, a research group of Mexican scholars collected information in Tlatelolco on a large number of bird species. They were writing a regional work on Mexican birds that would eventually be part of a comprehensive encyclopedia about the Spanish colony of New Spain (Mexico). While gathering data on the great-tailed grackle, they were told by their expert consultants and collaborators that this bird was not native to the area but had instead been introduced there by Aztec Emperor Auitzotl before the Spanish Conquest (Haemig 2012).

Sometime during the years 1486–1502, Auitzotl (also spelled Ahuitzotl) commanded that great-tailed grackles be brought to the Valley of Mexico from Aztec provinces in the Huastec (Teenek) and Totonac regions of Mexico (Haemig 1978, 2011). After the grackles were transported to the Valley of Mexico and released there, the Aztecs made two additional human interventions to ensure establishment of these exotic birds: (1) supplemental feeding and (2) protection from human harassment and predation (Haemig 1978, 2011). Nurtured and guarded by Mexico's most powerful ruler and his people, the grackles soon established themselves in their new home, multiplied and spread to other areas (Haemig 1978, 2011).

The research group that collected this information was led by Bernardino de Sahagún, an academic clergyman who had studied at the University of Salamanca in Spain (Anderson 1982). The other members of the research group, all native Mexican scholars, were either graduates and/or faculty members of the Royal College of the Holy Cross (El Imperio Colegio de la Santa Cruz) (Sahagún [1577] 1982; Haemig 2012). This College, located in Tlatelolco, was an elite European-style school that was a center for advanced learning and research in New Spain (Haemig 2012).

When Sahagún's research group were told the details of Auitzotl's introduction of the great-tailed grackle, they wrote them down in the Aztec language into a document now known as the *Manuscript of Tlatelolco* (Appendix A.1) Although the account they recorded does not specifically say that it is based on eye-witness-testimony, we cannot exclude that possibility. The account quotes the words of Aztec people guarding the

introduced great-tailed grackles, suggesting eyewitness testimony (Appendix A.2) and/or use of a pre-Hispanic pictorial manuscript that was itself based on one or more eyewitness sources (Appendix A.3). In addition, the research group later revealed that the city where they were then working (Tlatelolco), was one of the sites where Auitzotl had introduced the great-tailed grackles 59-79 years earlier (Haemig 2011).

Nevertheless, to further verify the authenticity of the account, Sahagún's research group had it peer reviewed by bird experts in another city where Auitzotl introduced the great-tailed grackle: the Aztec capital Tenochtitlan (Haemig 2011, 2012). After successfully passing this peer review, the research group wrote the historical account into a document now known as the *Manuscript of 1569*, which is regarded as the finished Aztec language version of their work (Appendix A.4). During the 1570s, the research group copied the Aztec texts of the entire great-tailed grackle account, together with a Spanish translation that included the scholia (i.e. glosses, explanations, critical comments, grammatical explanations, Appendix A.5) into the encyclopedia known today as the *Florentine Codex* (Appendix A.6). The complete bilingual texts of the historical account from the *Florentine Codex* read as follows:

Aztec Text (English Translation): It is named *teotzanatl* [divine, genuine, or marvelous grackle, see Appendix A.7] because it did not live here in Mexico in times of old. Later, in the time of the ruler Auitzotl it appeared here in Mexico. For he commanded that they be brought here from [the provinces of] Cuextlan [and] Totonacapan. It was made known especially that those which came here were to be fed. But when they multiplied, they scattered, they traveled everywhere, they ate everywhere. They eat lizards. And when they were still esteemed, no one might throw stones at them. If anyone stoned them, they chided one another; the common folk said to one another, "What are you doing over there? Do not shout at, do not stone the lord's birds!" (Sahagún [1577] 1963, p. 50).

Spanish Text: Llámanse teotzanatl que quiere decir ave rara, o tzanatl preciosa: Porque no son naturales desta tierra: No ha muchos años que vinieron a estas partes; cuando era señor Auitzotl vinieron a estas partes de México, por su mandado fueron traídas de las provincias de Cuextlan y Totonacapan. Y entonce tenían cargo de dar las de comer. Y como comenzaron a multiplicarse derramáronse por todas las comarcas de México. Estas comen lagartijas y otras sabandijas semejantes. A los principios nadie las usaban matar, ni tirar: porque estaba vedado por el señor. (Sahagún [1577] 1979, Volume 3, Book 11, folios 53v-54r).

Comparing the *Florentine Codex's* chapter on birds to the texts of the earlier *Manuscript of Tlatelolco*, we find that the *Codex* contains over thirty new bird accounts that are not present in the *Manuscript of Tlatelolco*, as well as significant new information on many birds already present in the latter (e.g. *Itzquauhtli*, *Mixcoaquauhtli*, *Itztlhotli*, *Chiqujmoli*, *Chachalacametl*). These many changes to the bird chapter, which appear both before and after the account of Auitzotl's introduction of the great-tailed grackle, were added by the peer reviewers in Tenochtitlan. They confirm Sahagún's statement that the *Tenochca* (people of Tenochtitlan, Appendix A.8) "amended and added many things to the twelve books" at that time (Sahagún [1577] 1982, p. 55), and also leave little doubt that the *Tenochca* scrutinized the grackle account (Appendix A.9). That

the *Tenochca* were familiar with the male great-tailed grackle is proven by the fact that this bird is specifically mentioned as a size model in the *Florentine Codex's* account of the *Chachalacametl* (Sahagun [1577] 1963, 1979), which was written in Tenochtitlan.

That the grackle account successfully passed the peer review process in Tenochtitlan is shown by the following facts: (1) The details of the introduction of the great-tailed grackle, as told in the Aztec and Spanish texts of the *Florentine Codex* (above), are not significantly different from those of the *Manuscript of Tlatelolco* (Haemig 2011, 2012), (2) No alternate account of the great-tailed grackle was added to the manuscript in Tenochtitlan, as was done for several bird accounts from Tlatelolco that the *Tenochca* judged unsatisfactory (e.g. *Atotolin*, *Atapalcatl*, *Itzquauhtli*, *Mixcoaquauhtli*, *Tolcomoctli*). (3) The account lacks warning phrases (Haemig 2012) that the research group used to alert the reader to doubtful information such as fables.

The account of Auitzotl's introduction of the great-tailed grackle is thus a peer-reviewed historical account, collected and authenticated by a professionally-trained research group within a human lifetime of the grackle translocation (Haemig 2012). The existence of this peer-reviewed historical account means that the evidence for Auitzotl's introduction of the great-tailed grackle is considerably better than what exists for many birds currently thought to have been translocated by humans (See examples in Long 1981; Lever 2005; Blackburn et al. 2009).

Compatibility with other sources

The credibility of the historical account is further enhanced by the fact that there is nothing in its content that casts doubt on its veracity. Its many details are consistent with what other sources tell us about both the Aztecs and great-tailed grackles.

For example, other historians confirm that the Aztecs moved many different kinds of organisms outside their natural ranges (Haemig 1978, 2011). In one particularly illuminating case, Auitzotl's mentor and closest advisor, Tlacaelel, persuaded an earlier Aztec emperor, Montezuma I, to create a large garden-park of exotic tropical plants south of the Aztec capital at Huaxtepec, in what is today northern Morelos (Duran [1581] 1994; Haemig 2011). Among Tlacaelel's many reasons for recommending that exotic plants be translocated to this area was his curiosity to see if the plants could thrive outside their natural ranges. In addition, he argued persuasively that "it will cost us little to find out" (Duran [1581] 1994; Haemig 2011, p. 394). Consequently, Montezuma commanded that many different species of tropical plants be brought to Huaxtepec from Cuetlaxtla (located in present-day Veracruz) to create this garden-park. Over forty professional gardeners from Cuetlaxtla, along with their wives and families, moved to Huaxtepec with the exotic plants so that the latter could be successfully established using horticultural methods from Cuetlaxtla (Duran [1581] 1994; Tezezomoc [1598] 1997).

We also know from other sources that the great-tailed grackle is not the only introduced bird species recorded from the Valley of Mexico. Nineteenth-century ornitholo-

gists listed about a dozen other exotic bird species as occurring there, including two icterids (*Amblycercus holosericeus*, *Cassiculus melanicterus*) and several species of parrots (Herrera 1888; Peterson and Narvarro-Sigüenza 2006; Haemig 2010). Whether or not these other species were also introduced by Aztec rulers is unknown. Since pre-Hispanic times, large numbers of exotic birds have been sold in the market places of Mexico City (Cortés [1520] 1971), so these species could be descended from escaped cagebirds and even date from more recent times. Nevertheless, the presence of so many exotic bird species in the Valley of Mexico suggests that this area, which is one of the great cradles of human civilization, has also been a theater for exotic bird introduction.

The reference in the historical account to common people protecting the grackles is also consistent with information from other sources. Haemig (2011, p. 392) explains:

"Diego Durán tells us that by 1486, the year Auitzotl became emperor, the Aztec nation was so well organized that there were special functionaries 'for every activity, even minor ones… There were even officials in charge of sweeping. The order was such that no one was allowed to interfere with the work of another or express an opinion since he would be rebuffed immediately" (Durán ([1581] 1994, p. 309)… Auitzotl was unique among Aztec emperors in that he promoted common people to official positions that had previously been held only by nobles (Durán [1581] 1994). When Auitzotl's successor, Montezuma II, became emperor, he removed common people from official positions, reversing the gains that commoners had made under Auitzotl (Durán ([1581] 1994). Because Auitzotl opened up Aztec society for the lower classes, he was popular with them. Consequently, the common people may have enthusiastically protected "the lord's birds" not just out of fear and respect, or because it was their job to protect the grackles, but also out of gratefulness and love for their emperor."

The historical account states that the grackles were brought from Cuextlan and Totonacapan and released in the Valley of Mexico. Here again, we find consistency with other sources: the race of the great-tailed grackle inhabiting the Valley of Mexico (*Q. m. mexicanus*) is the same as that which inhabits Cuextlan and Totonacapan (Haemig 1978).

The historical account further states that the great-tailed grackles introduced by Auitzotl became invasive and ubiquitous:

"But when they [the introduced grackles] multiplied, they scattered, they traveled everywhere, they ate everywhere" (Aztec text – Sahagún [1577] 1963, p.50).

"And when they [the introduced grackles] began to multiply, they spread themselves through all the territories of Mexico" (Spanish text – Sahagún [1577] 1979, vol. 3, book 11, folios 53v-54r).

These descriptions sound very much like the great-tailed grackle we know today, which is greatly expanding its geographic range (Phillips 1950; Dinsmore and Dinsmore 1993) and is widespread in urbanized environments (González Oreja et al. 2007; Ortega-Álvarez and MacGregor-Fors 2009; Carbó-Ramírez and Zuria 2011; González Oreja 2011; Pineda-Lopez et al. 2013).

The historical account mentions that people had to be restrained from shouting at the introduced great-tailed grackles, suggesting that these birds had become pests. (The

account also states that people had to be prevented from throwing stones at the grackles and killing them, but in these latter cases it is unclear if the grackles were wanted dead because they were pests or to obtain their valuable feathers). Great-tailed grackles in modern times are often persecuted as pests too and humans sometimes shout and throw stones at them. So once again the details of the historical account resonate completely with current knowledge and experience.

Critique of dissenting views

Remsen and Cardiff (1990) disputed the historical account. Because all subsequent authors who have questioned the historical account (Christensen 2000; Peer 2011) continue to cite and rely heavily on Remsen and Cardiff's paper, it is essential to review and answer all of its points. Remsen and Cardiff's criticisms of the historical account fall into four categories: (1) caricature of the *Florentine Codex*, (2) objection to the use of indirect observations, (3) objection to the presentation of evidence that conflicts with the hypothesis of natural invasion, and (4) objection to the use of information from indigenous peoples. Let us now examine in detail these criticisms.

Caricature

A significant part of Remsen and Cardiff's critique of the historical account consists of distorted and inaccurate descriptions. They caricature the *Florentine Codex* as "a friar's 1577 collection of animal stories", belittle the peer-reviewed historical account as "folklore", and call the highly-civilized and literate Aztecs "primitive peoples".

Remsen and Cardiff's (1990) caricature of the *Florentine Codex* gives the impression that this work is hopelessly out-of-date, written by a non-scholar, and contains no useful scientific information. Like most caricatures, it is inaccurate because it omits many important details and trivializes others. For example, while it is true that Sahagún was a (Franciscan) friar, Remsen and Cardiff neglect to mention that he was also a serious scholar, teacher and leader of a distinguished academic research group (Lopez Austin 1974; Anderson 1982; Nicolau d'Olwer 1987; Leon-Portilla 2002). In 1536, Sahagún helped found the Royal College of the Holy Cross (described above) in Tlatelolco. While working at this college, Sahagún taught the brightest children of the former native nobility and mentored several who went on to became distinguished scholars.

Later, during a twenty year period (1558–1577), Sahagún directed the General History Project, which cumulated in the writing of a peer-reviewed encyclopedia (the *Florentine Codex*) that contained a wealth of important new information about Mexico that was unknown to science. Comparing him to other friars of his time, Anderson, (1982, p. 41) wrote: "While Sahagún clearly reflected the views and methods of his time and of his order, he nevertheless stands absolutely unique…Even when compared

with his ablest contemporaries he excelled any of them in his ability to organize, train, use, and direct effectively a team of emerging native scholars."

Remsen and Cardiff's caricature also leaves the false impression that the *Florentine Codex* was written by one person. In reality, this encyclopedia was produced by a group of scholars in collaboration with indigenous experts in the various topics studied. While Sahagún was the leader of the project, much of the research and fieldwork was done by four distinguished trilingual scholars: Martin Jacobita, Antonio Valeriano, Alonso Vegerano, and Pedro de San Buenaventura (Sahagún [1577] 1982). Because Sahagún was the only member of the research group that was a clergyman, it is inaccurate and misleading to characterize the authorship of the *Florentine Codex* as a "friar's" work.

Third, the *Florentine Codex* is far more than a "collection of animal stories." Covering a wide variety of topics, it contains the first scholarly descriptions of flora and fauna for many species in the New World. In the prologue to Book Eleven of the *Florentine Codex*, where the account of Auitzotl's introduction of the great-tailed grackle is found, Sahagún ([1577] 1982, p. 87) summarizes the contents of this volume as follows: "In it, recorded in the Mexican language, are the better known and most utilized animals, birds, fish, trees, herbs, flowers, and fruits which exist in all this land - their characteristic properties and traits, exterior and interior."

The account of Auitzotl's introduction of the great-tailed grackle is found in Chapter Two of Book Eleven. This chapter focuses on birds and describes many species. Included are not only physical descriptions and names but also other information, such as habitat, song, nesting habits, eggs, behavior and interactions with humans. Thus, among other things, Chapter Two of Book Eleven is a serious scholarly attempt to summarize the better known and most utilized birds of the Spanish colony of New Spain. Because its Aztec texts were finished in 1569, three years before Francisco Hernandez came to New Spain, it may be the earliest-known regional avifaunal work on the birds of Mexico.

Indirect observations

As shown in the previous section, the *Florentine Codex's* bird chapter is a regional avifaunal work. Regional works on birds review and summarize the existing state of knowledge of birds in a given area, and so are usually based at least partially on the work of others. Important historical information, such as the introduction of exotic bird species, is often mentioned in regional works and is almost never based on the direct observations of the authors themselves (e.g. Berger 1972**;** Cramp et al. 1977-1996; AOU 1998). It is therefore astonishing to read that Remsen and Cardiff (1990, p. 973) criticize the historical account because, in their words, it comes from "Aztec informants (and not the friar's direct observations)".

Although Peer (2011) gave credence to Remsen and Cardiff's argument by uncritically quoting it, he failed to note that Remsen and Cardiff themselves use indirect sources and so could be accused of imposing a double standard. For example, a year before Remsen and Cardiff (1990) criticized "the friar" for reporting the great-tailed

grackle's introduction without directly observing it, Remsen reported in a regional work on Bolivian avifauna that two bird species of that county were introduced (Remsen and Traylor 1989). Like Sahagún's research group, Remsen and Traylor (1989) did not directly observe the introduction of these two exotic species by humans, but had instead obtained their knowledge of these birds' introduced status indirectly, from sources which they knew to be reliable.

Six years after criticizing "the friar", Remsen et al. (1996) published another regional work, this time on vireo migration in Louisiana. In that paper, Remsen and Cardiff stated that some of the data they used were not based on their own direct observations but instead came from amateur bird watchers. They explained, "Some previously unpublished observations were obtained from the card file of unusual bird sightings reported to the regional editors of *Audubon Field Notes - American Birds - National Audubon Society Field Notes* (Remsen et al. 1996, p. 123)."

Because Remsen and Cardiff use indirect information that they judge to be reliable, it is hard to understand why they object to Sahagún's research group doing the same. More important, it is quite common in scientific work to use reliable indirect information. For example, most modern-day scientific papers have a section titled "References" or "Literature Cited" where the authors cite sources that contributed indirectly to the work. Most also have a section titled "acknowledgements", where unpublished sources that contributed indirect information, such as museums, databases, other researchers, etc. are thanked. While direct observations are the ideal, they are not always necessary nor even possible. In the present case, Sahagún's research group was not able to travel back in time to Auitzotl's reign to witness the grackle introduction directly, and so had to depend upon interviews and/or pictorial manuscripts. Needless to say, all good data, whether direct or indirect, gain more credibility when they are peer reviewed by experts, as was the account of Auitzotl's introduction of the great-tailed grackle (Haemig 2012).

The natural invasion hypothesis

Some critics have suggested that the Aztecs confused, or may have confused, a natural invasion of great-tailed grackles for an introduction (Remsen and Cardiff 1990; Christensen 2000; Peer 2011). However, none of these critics have presented evidence that such confusion happened or that a natural invasion occurred during Auitzotl's reign.

In an earlier paper (Haemig 2012), I showed why it is highly unlikely that the historical account is the result of confusion. The investigative methods used by Sahagún's research group were designed to avoid, detect and correct any possible confusion. For example, the research group consulted and collaborated with native experts that had reputations for integrity. If any of their consultants and collaborators in Tlatelolco had really become confused, it is likely that the research group would have discovered the confusion when the account was peer reviewed in Tenochtitlan. Furthermore, many

Table 1. Examples of bird species that occur in both North America and Europe. Note that the existence of species native to both continents (Column 1), does not rule out the existence of species introduced by humans to one or both of the continents (Columns 2, 3 and 4). Data from AOU (1998) and Cramp et al. (1977–1996).

Species natural to both continents	Species natural to Europe but introduced in North America	Species natural to North America but introduced in Europe	Species introduced to both continents
Mallard (*Anas platyrhynchos*)	Mute Swan (*Cygnus olor*)	Canada Goose (*Branta canadensis*)	Mandarin Duck (*Aix galericulata*)
Willow Grouse (*Lagopus lagopus*)	Grey Partridge (*Perdix perdix*)	Wild Turkey (*Meleagris gallopavo*)	Pheasant (*Phasianus colchicus*)
Barn Owl (*Tyto alba*)	Rock Dove (*Columba livia*)	Northern Bobwhite (*Colinus virginianus*)	Monk Parakeet (*Myiopsitta monachus*)
Winter Wren (*Troglodytes troglodytes*)	Starling (*Sturnus vulgaris*)	Ruddy Duck (*Oxyura jamaicensis*)	Common Myna (*Acridotheres tristis*)
Sand Martin (*Riparia riparia*)	House Sparrow (*Passer domesticus*)		
Waxwing (*Bombycilla garrulus*)			

details of the grackle translocation are given in the account. If confusion had really occurred, one would expect to find differences in the various details in the texts from the two cities. Instead, there were no substantive differences between the Aztec and Spanish texts written before and after peer review (Haemig 2011, 2012).

Remsen and Cardiff (1990) argued that since other bird species colonized the Mexican Highlands without human help, the great-tailed grackle must also have done so. They wrote, "the Mexican Plateau region inhabited by the grackle is also inhabited by disjunct, highland populations of other normally lowland species…for which a hypothesis of human introduction is untenable (p. 973)." Therefore, they concluded, the great-tailed grackle's distribution was "readily explained within the context of broader distribution patterns, and that there is no need to invoke human intervention (p. 973)."

Remsen and Cardiff's argument is based on the assumption that similar distributions are the result of similar dispersal histories. However, this is not always true. Consider the following examples: Europe and North America, like the highlands and lowlands of Mexico, have many bird species in common. Some are native to both continents, while others are native to one continent and introduced on the other (Table 1). If we follow Remsen and Cardiff's reasoning that the presence of species native to both areas rules out the possibility of there also being birds native to one of the areas but introduced in the other, we would erroneously conclude that the starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*) and mute swan (*Cygnus olor*) invaded North America naturally. Likewise, the presence of naturally-occurring neotropical birds in Florida, like the mangrove cuckoo (*Coccyzus minor*), snail kite (*Rostrhamus sociabilis*), shiny cowbird (*Molothrus bonariensis*) and smooth-billed ani (*Crotophaga ani*) does not prove that other neotropical birds there, such as the spot-breasted oriole (*Icterus pectoralis*), were not introduced by humans.

Remsen and Cardiff (1990), as well as Christensen (2000) and Peer (2011), cite the great-tailed grackle's modern invasion of areas in the United States (Wehtje 2003) as evidence to support the natural invasion hypothesis. However, this fact does not disprove Auitzotl's introduction of the great-tailed grackle, and can just as easily be used to support the introduction hypothesis because it confirms a claim made by the historical account: that the introduced grackles multiplied and spread to other areas.

Finally, I must comment on Remsen and Cardiff's oft-quoted argument that "there is no need to invoke human intervention" because the great-tailed grackle's presence in the "Mexican Plateau region" is "readily explained within the context of broader distribution patterns" (p. 973). I find this argument to be unpersuasive. Remsen and Cardiff are in essence telling us to ignore good evidence (a credible historical account) because it threatens their favorite hypothesis.

Indigenous sources

Remsen and Cardiff (1990) concluded their critique of the historical account by attacking its source. Noting that the account came from indigenous peoples, they argued that such peoples cannot be trusted because they sometimes make errors. Remsen and Cardiff explained:

"Although the plausibility and detail of the latter [the historical account] are intriguing, we regard such folklore with distrust. Our personal experience with South American indigenous peoples as well as with "educated" peoples is sprinkled with cases of amusing, but obviously erroneous, explanations of past and present natural phenomena, in spite of detailed and accurate knowledge of natural history in other cases (Remsen and Cardiff 1990, p. 973)."

I know of no other case in the introduced species literature where a credible historical account documenting bird introduction (and even identifying the person responsible for the introduction) has been questioned using negative stereotypes of folk groups. I also find it amazing that Remsen and Cardiff (1990) categorize indigenous peoples separately from "educated" peoples as though indigenous peoples are never educated.

Over the years, I have met other individuals who dispute the historical account because it comes from indigenous sources. Seldom, if ever, does anyone accuse Europeans, or their descendants, of confusing natural invasions with introductions. Yet, as soon as American Indians are identified as the source of information, critics tell us that the information cannot be trusted, that the Aztecs might have been confused - in spite of the fact that the historical account was collected and verified by professionally-trained scholars (Lopez Austin 1974; Haemig 2012). The old falsehood that American Indians are more easily confused than others and cannot keep their facts straight has been a powerful, enduring myth in the Americas, one used for centuries to cover up crimes against native peoples such as treaty violations, war provocations, genocide and land theft, and to argue that surviving Indians need colonial authorities to manage their lands, resources and histories. As professional scientists, we need to recognize that prejudices such as these can hinder the search for truth.

Discussion

I am sometimes asked why Sahagún's research group did not collect and preserve specimens of the great-tailed grackle for us to examine. The answer is that they lived long before the era of scientific collecting and so, like most scholars of their time, modeled their work instead after classical giants like Pliny and Aristotle.

Furthermore, when Sahagún's research group worked in the 16th century, the methods and technologies for long-term preservation of bird skins (with their feathers) had not yet been invented (Walters 2003). Stresemann (1975, p. 27) writes that before the 18th century "many birds, dead and alive," were shipped to Europe but "none of the birds lasted very long: …the dried skins, which no one knew how to impregnate, were eaten by moths and dermestids". Thus, even if Auitzotl's Aztecs or Sahagún's research group could have predicted future research methodologies and tried to save skins of grackles for us to inspect today, it is doubtful if those specimens would have survived the centuries.

Although Sahagún's research group did not preserve specimens of the great-tailed grackle, they wrote an excellent, detailed description of it (Sahagún [1577] 1979, vol. 3, book 11, folios 53v-54r, Sahagún [1577] 1963, p.50). Their description matches the great-tailed grackle and leaves no doubt that the bird which the Aztecs called *Teotzánatl* is *Quiscalus mexicanus* (Appendix A.7).

Today, we have better scientific methods and technologies than Sahagún's research group had when they worked over four hundred years ago. Yet, and this is humbling to admit, Sahagún's research group had a least one advantage over us: They lived in Mexico at a time when experts from Auitzotl's reign were still alive and when many pre-Hispanic pictorial manuscripts were still extant. In other words, they had access to good sources of information that are no longer available to us, and they tapped these sources using the best scholarly research methods of their time. I therefore believe that, unless convincing evidence to the contrary can be presented, we have a greater likelihood of knowing the truth about Auitzotl's introduction of the great-tailed grackle if we trust the careful work of Sahagún's research group rather than the speculations of persons living today, over 400 years later.

Some critics claim that "insufficient evidence" has been presented to prove that the great-tailed grackle was introduced into the Valley of Mexico by Aztec Emperor Auitzotl (Remsen and Cardiff *in* Christensen 2000). That claim is debatable, since there are different opinions as to what constitutes sufficient evidence. But at least Sahagún's research group presented a highly-credible, peer-reviewed historical account - better documentation than what is available for many birds currently classified as introduced. In contrast, the proponents of the natural invasion hypothesis have to date presented no historical account of grackles naturally invading the Aztec capital during Auitzotl's reign, and have failed completely in their attempts to discredit the *Florentine Codex's* account of introduction.

There is no evidence for natural invasion of the Valley of Mexico by great-tailed grackles during the reign of Auitzotl. On the other hand, there is good evidence for intro-

duction by Aztecs. That evidence comes from the authentic historical account preserved in the *Florentine Codex*. It is hard to find a more credible and reliable ancient source than this encyclopedia, for it was the product of many years of research by the top scholars of sixteenth-century Mexico, who used the most rigorous and demanding methods of investigation for their time, including peer-review, to ensure that their work was truthful and reliable (Haemig 2012). If we throw out the historical account of Auitzotl's introduction of the great-tailed grackle, we must in all fairness throw out much of mankind's history of the ancient world, for a great amount of the latter was collected and recorded under far less rigorous standards than that employed by Sahagún's research group.

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Appendix

A.1. The original *Manuscript of Tlatelolco* is preserved today in the Biblioteca de la Real Academia de la Historia in Madrid, Spain (Haemig 2012). A facsimile copy of the page from that manuscript with the account of Auitzotl's introduction of the great-tailed grackle can be seen in Sahagún [1565] 1907, folio 259v. It is written in Aztec (classical Nahuatl).

A.2. Sahagún's research group collected much of their information from Aztec elders who, in their youth, may have been eyewitnesses to Auitzotl's introduction of the great-tailed grackle (Sahagún [1577] 1979, 1982; Haemig 2011, 2012).

A.3. Sahagún ([1577] 1979, 1982) stated specifically that some of the information his research group collected came from extant pre-Hispanic pictorial manuscripts. For example, writing of his group's earlier fieldwork in Tepepulco during the years 1558-1561, Sahagún mentioned that their consultants and collaborators there gave them "all the matters we discussed in pictures, for that was the writing they employed in ancient times"(Sahagún [1577] (1982) p. 54). Another historian, Diego Duran, wrote that by 1486, the year Auitzotl became emperor, the Aztec nation was so well organized that officials kept records of everything: "This nation had a special functionary for every activity, even minor ones. *Everything was so well recorded that no detail was left out of the accounts and registers*" [emphasis mine] (Duran [1581] 1994, p. 309). Because the introduction of the great-tailed grackle was the result of a specific command by the emperor, it may have been considered important enough to be documented in pictorial manuscripts.

A.4. The *Manuscript of 1569* is now lost, however its Aztec texts were copied into the *Florentine Codex* during the 1570s (Sahagún [1577] 1979, 1982; Dibble 1982).

A.5. The Spanish texts in the bird chapter of the *Florentine Codex* are critical abstracts of the Aztec language bird accounts that appear to incorporate, among other things, details from the Aztec texts as well as additional information including comments added during peer-review in Tenochtitlan. In 1569, Sahagún specifically stated that it had not yet been possible to provide the *Manuscript of 1569* with the scholia and Spanish translations (Sahagún [1577] 1982, p.46). At that time, it was intended to make three columns on every page: one column each for the Aztec text, Spanish Text and the scholia (Sahagún [1577] 1982, p.51). However, when the *Florentine Codex* was later produced, each page contained only two columns, one for the Aztec text and one for the Spanish text with scholia.

A.6. A facsimile copy of the *Florentine Codex's* pages with the account of Auitzotl's introduction of the great-tailed grackle in both the Aztec and Spanish texts can be seen in Sahagún [1577] 1979, vol. 3, book 11, folios 53v-54r.

A.7. Martin del Campo (1940) identified the *Teotzanatl* as the Great-tailed Grackle. See Christensen (2000) and the Appendix of Haemig (2010) for confirmation of this identification.

A.8. To avoid confusion, I use the word *Tenochca* rather than Sahagún's *Mexicanos*, because it is clear from sentences proceeding and following the quoted passage that Sahagún uses *Mexicanos* in a very restricted sense to mean only people of Tenochtitlan (Sahagún [1577] 1982, p.41).

A.9. The many changes seen in the Aztec text of the *Florentine Codex* (compared to the *Manuscript of Tlatelolco*) also show that these texts were copied from the *Manuscript of 1569* rather than the *Manuscript of Tlatelolco* (Sahagún [1577] 1979, 1982).